19-2021; Rev 4; 7/11

MAXIM

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

General Description

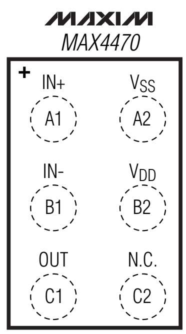
The MAX4464/MAX4470/MAX4471/MAX4472/MAX4474 family of micropower op amps operate from a single +1.8V to +5.5V supply and draw only 750nA of supply current. The MAX4470 family feature ground-sensing inputs and rail-to-rail output. The ultra-low supply current, low-operating voltage, and rail-to-rail output capabilities make these operational amplifiers ideal for use in single lithium ion (Li+), or two-cell NiCd or alkaline battery systems.

The rail-to-rail output stage of the MAX4464/MAX4470/MAX4471/MAX4472/MAX4474 amplifiers is capable of driving the output voltage to within 4mV of the rail with a 100kΩ load, and can sink and source 11mA with a +5V supply. These amplifiers are available in both fully compensated and decompensated versions. The single MAX4470, dual MAX4471, and the quad MAX4472 are unity-gain stable. The single MAX4464 and the dual MAX4474 are stable for closed-loop gain configurations of ≥ +5V/V. These amplifiers are available in space-saving WLP, SC70, SOT23, µMAX®, and TSSOP packages.

Applications

- Battery-Powered Systems
- Portable Instrumentation
- Pagers and Cellphones
- Micropower Thermostats
- Electrometer Amplifiers
- Solar-Powered Systems
- Remote Sensor Active Badges
- pH Meters

Pin Configurations



WLP BUMP SIDE DOWN

Pin Configurations continued at end of data sheet.

Features

- ♦ **Ultra-Low 750nA Supply Current Per Amplifier**
- ♦ **Ultra-Low +1.8V Supply Voltage Operation**
- ♦ **Ground-Sensing Input Common-Mode Range**
- ♦ **Outputs Swing Rail-to-Rail**
- ♦ **Outputs Source and Sink 11mA of Load Current**
- ♦ **No Phase Reversal for Overdriven Inputs**
- ♦ **High 120dB Open-Loop Voltage Gain**
- ♦ **Low 500µV Input Offset Voltage**
- ♦ **9kHz Gain-Bandwidth Product (MAX4470/MAX4471/MAX4472)**
- ♦ **40kHz Gain-Bandwidth Product (MAX4464/MAX4474)**
- ♦ **250pF (min) Capacitive Load Capability**
- ♦ **Available in Tiny, 6-Bump WLP, 5-Pin SC70, and 8-Pin SOT23 Packages**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX4464EXK+T	-40°C to +85°C	5 SC70	+ABT
MAX4464EUK+T	-40°C to +85°C	5 SOT23	+ADPI
MAX4470EXK+T	-40°C to +85°C	5 SC70	+ABS
MAX4470EUK+T	-40°C to +85°C	5 SOT23	+ADPH
MAX4470EWT+	-40°C to +85°C	6 WLP	+BP
MAX4471EKA+T	-40°C to +85°C	8 SOT23	+AAEK
MAX4471ESA+	-40°C to +85°C	8 SO	—
MAX4472EUD+	-40°C to +85°C	14 TSSOP	—
MAX4472ESD+	-40°C to +85°C	14 SO	—
MAX4474EKA+T	-40°C to +85°C	8 SOT23	+AAEL
MAX4474EUA+	-40°C to +85°C	8 µMAX	—
MAX4474ESA+	-40°C to +85°C	8 SO	—

+Denotes a lead(Pb)-free/RoHS-compliant package.

Selector Guide

PART	NO. OF AMPLIFIERS	GAIN-BANDWIDTH	MINIMUM STABLE GAIN
MAX4464	1	40kHz	5V/V
MAX4470	1	9kHz	1V/V
MAX4471	2	9kHz	1V/V
MAX4472	4	9kHz	1V/V
MAX4474	2	40kHz	5V/V

ABSOLUTE MAXIMUM RATINGS

V_{DD} to V_{SS} ....-0.3V to +6V
IN_+ or IN_-....................(V_{SS} - 0.3V) to (V_{DD} + 0.3V)
OUT_ Shorted to V_{SS} or V_{DD}....................Continuous
Continuous Power Dissipation (T_A = +70°C)
5-Pin SC70 (derate 3.1mW/°C above +70°C)..........247mW
5-Pin SOT23 (derate 7.1mW/°C above +70°C)..........571mW
6-Bump WLP (derate 10.5mW/°C above +70°C)..........840mW
8-Pin SOT23 (derate 8.9mW/°C above +70°C)..........714mW
8-Pin μMAX (derate 4.5mW/°C above +70°C)..........362mW
8-Pin SO (derate 5.88mW/°C above +70°C)..........471mW
14-Pin TSSOP (derate 9.1mW/°C above +70°C)..........727mW
14-Pin SO (derate 8.33mW/°C above +70°C)..........667mW
Operating Temperature Range ....-40°C to +85°C
Junction Temperature ....+150°C
Storage Temperature Range..........-65°C to +150°C
Lead Temperature (soldering, 10s) ....+300°C
Soldering Temperature (reflow) ....+260°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, V_{OUT} = V_{DD}/2, R_L = ∞ to V_{DD}/2, **T_A = +25°C**, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{DD}	Guaranteed by PSRR tests		1.8		5.5	V
Supply Current (Per Amplifier)	I_{DD}	V_{DD} = +1.8V			0.6		μA
		V_{DD} = +5.0V			0.75	1.2	
Input Offset Voltage	V_{OS}				±0.5	±7.0	mV
Input Bias Current	I_B				±200	±1500	pA
Input Offset Current	I_{OS}				±12.5		pA
Input Common-Mode Voltage Range	V_{CM}	Guaranteed by the CMRR test		V_{SS}		V_{DD} - 1.1	V
Common-Mode Rejection Ratio	CMRR	Specified with $V_{SS} \le V_{CM} \le (V_{DD} - 1.1V)$		70	95		dB
Power-Supply Rejection Ratio	PSRR	$+1.8V \le V_{DD} \le +5.5V$		70	90		dB
Large-Signal Voltage Gain	A_{VOL}	R_L = 1MΩ, V_{OUT} = 50mV to V_{DD} - 50mV		90	120		dB
		R_L = 100kΩ, V_{OUT} = 200mV to V_{DD} - 200mV		90	112		
		R_L = 10kΩ, V_{OUT} = 200mV to V_{DD} - 200mV			100		
Output Voltage Swing	V_{OH}	Swing high specified as V_{DD} - V_{OH}	R_L = 1MΩ		1	4	mV
			R_L = 100kΩ		4	10	
			R_L = 10kΩ		40		
	V_{OL}	Swing low specified as V_{OL} - V_{SS}	R_L = 1MΩ		0.5	5	
			R_L = 100kΩ		1	5	
			R_L = 10kΩ		10		
Gain-Bandwidth Product	GBW	MAX4470/MAX4471/MAX4472			9		kHz
		MAX4464/MAX4474			40		
Phase Margin	ϕ_M	MAX4470/MAX4471/MAX4472			90		degrees
		MAX4464/MAX4474			80		

ELECTRICAL CHARACTERISTICS (continued)

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, V_{OUT} = V_{DD}/2, R_L = ∞ to V_{DD}/2, **T_A = +25°C**, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Slew Rate	SR	V_{OUT} = 4V step	MAX4470/MAX4471/MAX4472		2		V/ms
			MAX4464/MAX4474		20		
Input Voltage Noise	e_n	f = 1kHz			150		nV/√Hz
		f = 10kHz			120		
Output Short-Circuit Current		Shorted to V_{SS} (sourcing)			11		mA
		Shorted to V_{DD} (sinking)			36		
Power-On Time	t_{ON}				3		ms
Power-Off Time	t_{OFF}				2		µs
Capacitive Load	C_{LOAD}	No sustained oscillations		250			pF

ELECTRICAL CHARACTERISTICS

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, V_{OUT} = V_{DD}/2, R_L = ∞ to V_{DD}/2, **T_A = T_{MIN} to T_{MAX}**, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{DD}	Guaranteed by PSRR tests		1.8		5.5	V
Supply Current (Per Amplifier)	I_{DD}	V_{DD} = +5.0V				1.5	µA
Input Offset Voltage	V_{OS}					±15	mV
Input Offset Voltage Temperature Coefficient	TCV_{OS}				8		µV/°C
Input Bias Current	I_B					4.25	nA
Input Common-Mode Voltage Range	V_{CM}	Guaranteed by the CMRR test		V_{SS}		V_{DD} - 1.1	V
Common-Mode Rejection Ratio	CMRR	$V_{SS} \le V_{CM} \le (V_{DD}$ - 1.1V)		56			dB
Power-Supply Rejection Ratio	PSRR	+1.8V ≤ V_{DD} ≤ +5.5V, 0°C ≤ T_A ≤ +85°C		65			dB
		+2V ≤ V_{DD} ≤ +5.5V, -40°C ≤ T_A ≤ +85°C		65			
Large-Signal Voltage Gain	A_{VOL}	V_{OUT} = 50mV to V_{DD} - 50mV, R_L = 1MΩ		75			dB
		V_{OUT} = 200mV to V_{DD} - 200mV, R_L = 100kΩ		75			
Output Voltage Swing	V_{OH}	Swing high specified as V_{DD} - V_{OH}	R_L = 1MΩ			5	mV
			R_L = 100kΩ			15	
	V_{OL}	Swing low specified as V_{OL} - V_{SS}	R_L = 1MΩ			5	
			R_L = 100kΩ			5	

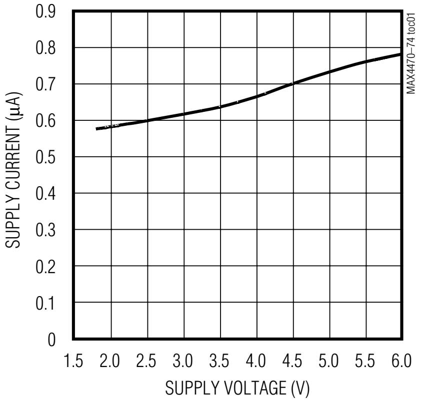
Note 1: All devices are production tested at T_A = +25°C. All temperature limits are guaranteed by design.

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

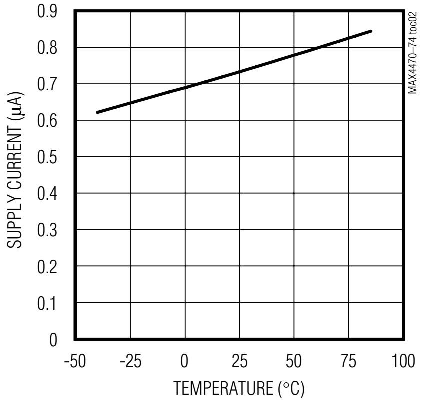
Typical Operating Characteristics

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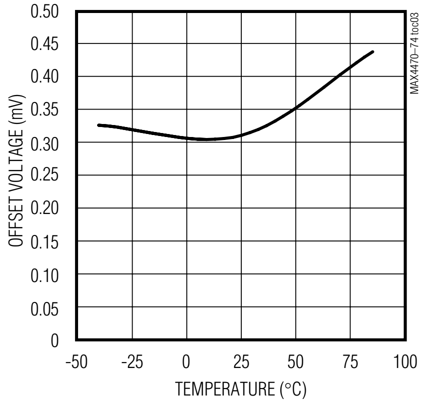
SUPPLY CURRENT PER AMPLIFIER vs. SUPPLY VOLTAGE



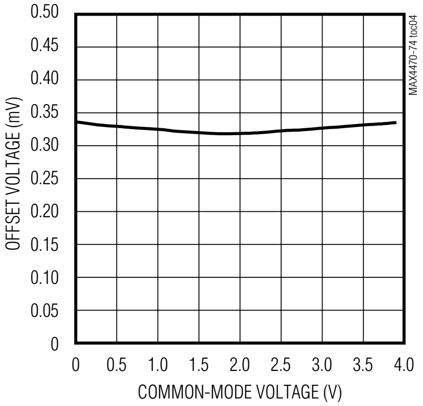
SUPPLY CURRENT PER AMPLIFIER vs. TEMPERATURE



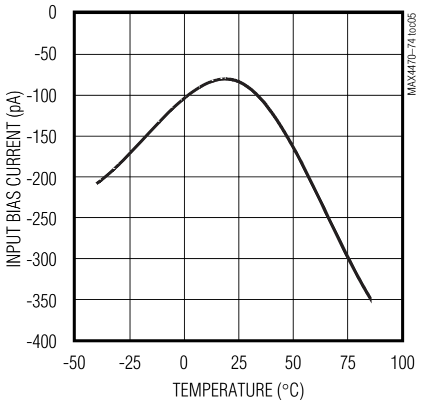
OFFSET VOLTAGE vs. TEMPERATURE



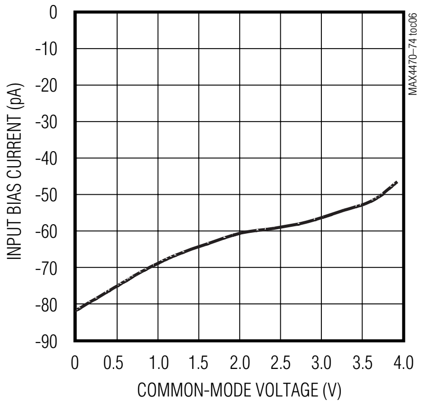
OFFSET VOLTAGE vs. COMMON-MODE VOLTAGE



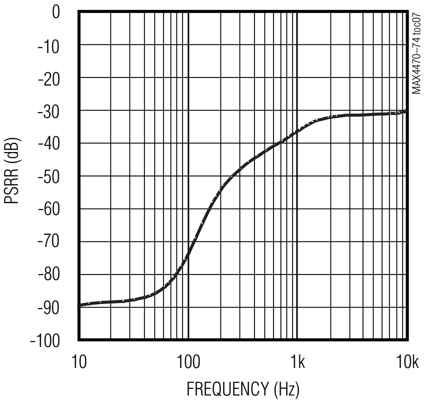
INPUT BIAS CURRENT vs. TEMPERATURE



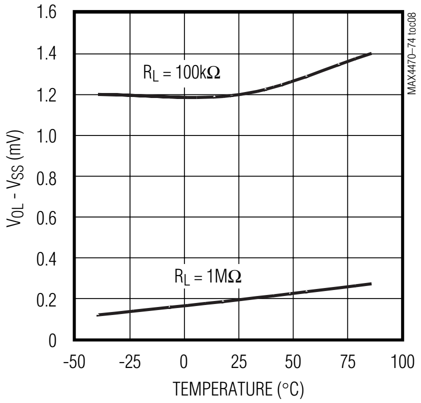
INPUT BIAS CURRENT vs. COMMON-MODE VOLTAGE



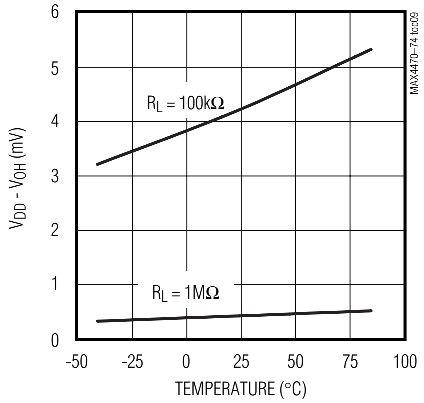
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



OUTPUT VOLTAGE SWING LOW vs. TEMPERATURE



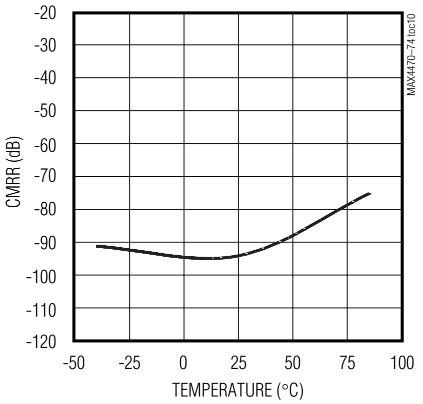
OUTPUT VOLTAGE SWING HIGH vs. TEMPERATURE



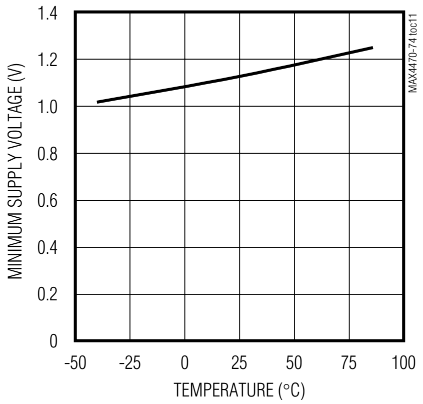
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

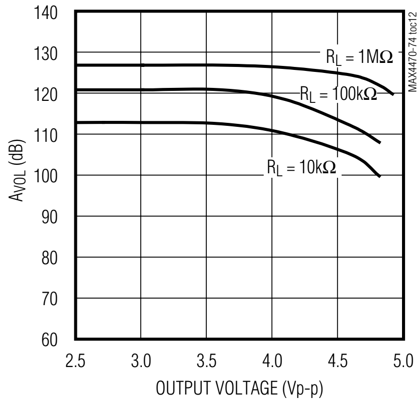
COMMON-MODE REJECTION RATIO vs. TEMPERATURE



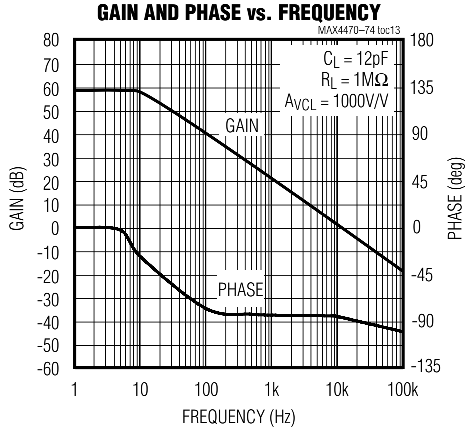
MINIMUM SUPPLY VOLTAGE vs. TEMPERATURE



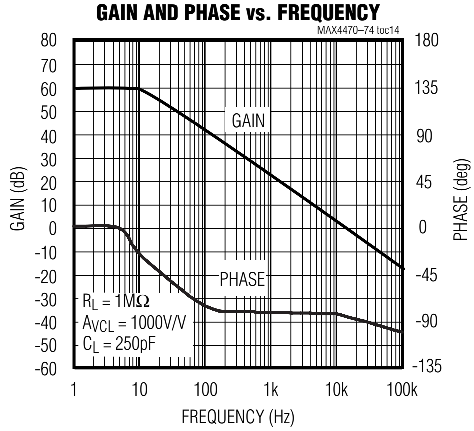
A_{VOL} vs. OUTPUT VOLTAGE SWING



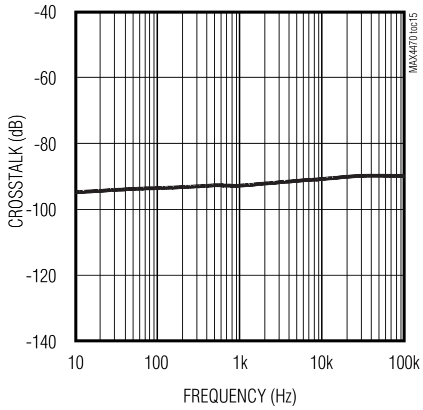
MAX4470/MAX4471/MAX4472 GAIN AND PHASE vs. FREQUENCY



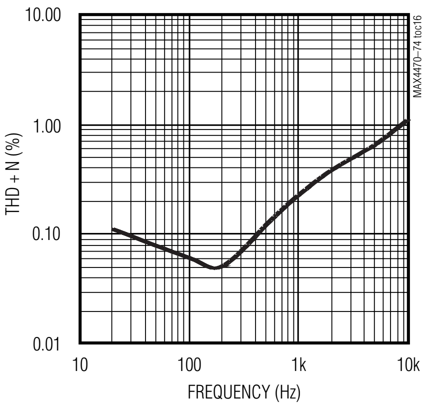
MAX4470/MAX4471/MAX4472 GAIN AND PHASE vs. FREQUENCY



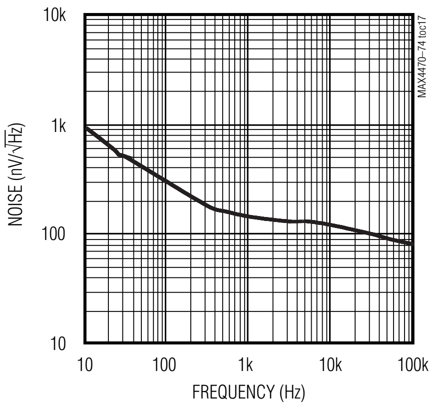
CROSSTALK vs. FREQUENCY



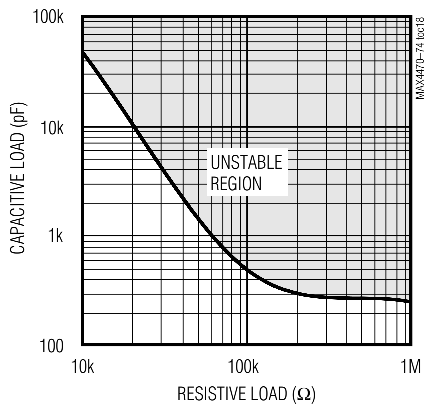
MAX4470/MAX4471/MAX4472 TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY



VOLTAGE NOISE DENSITY vs. FREQUENCY



MAX4470/MAX4471/MAX4472 STABILITY vs. CAPACITIVE AND RESISTIVE LOADS

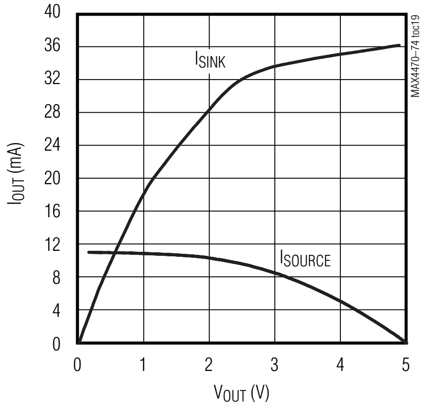


Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

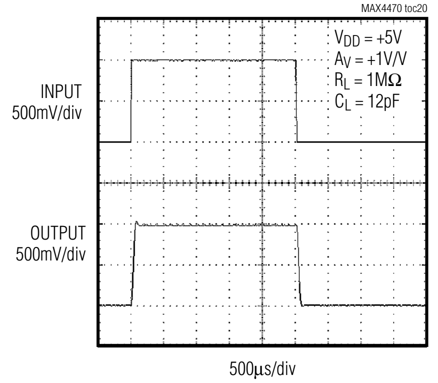
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

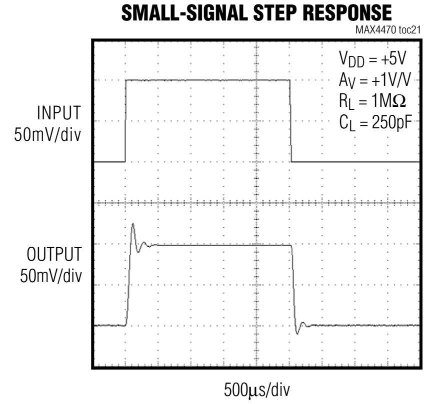
I_{OUT} vs. V_{OUT}



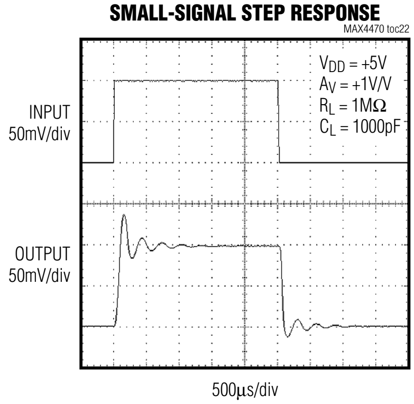
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL STEP RESPONSE



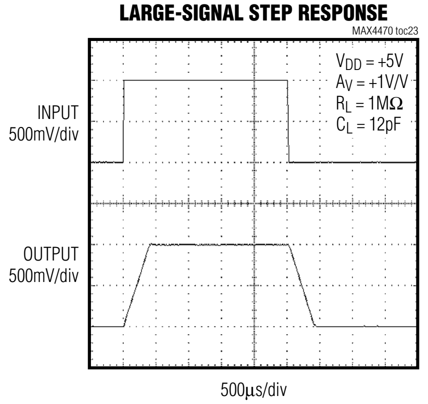
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL STEP RESPONSE



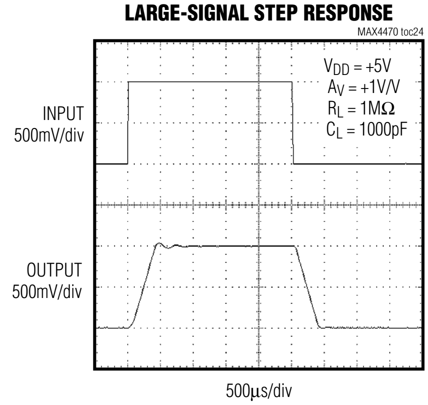
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL STEP RESPONSE



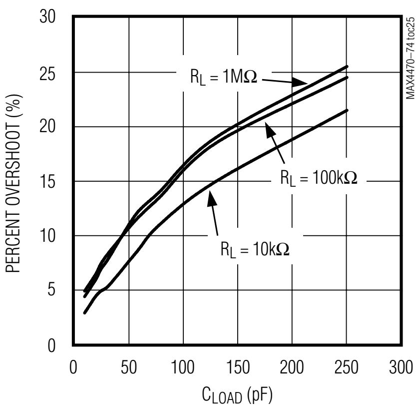
MAX4470/MAX4471/MAX4472 LARGE-SIGNAL STEP RESPONSE



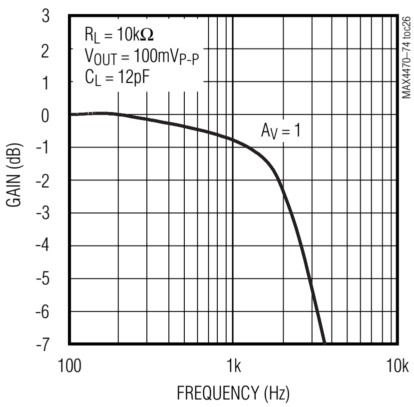
MAX4470/MAX4471/MAX4472 LARGE-SIGNAL STEP RESPONSE



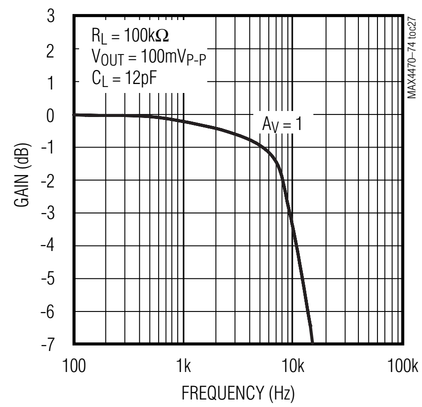
MAX4470/MAX4471/MAX4472 PERCENT OVERSHOOT vs. CAPACITIVE LOAD



MAX4470/MAX4471/MAX4472 SMALL-SIGNAL GAIN vs. FREQUENCY



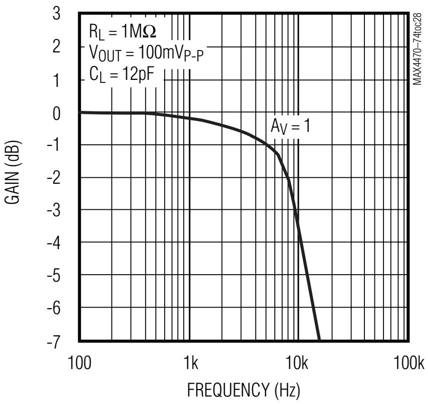
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL GAIN vs. FREQUENCY



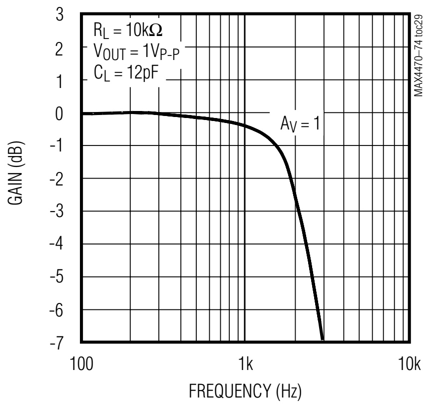
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

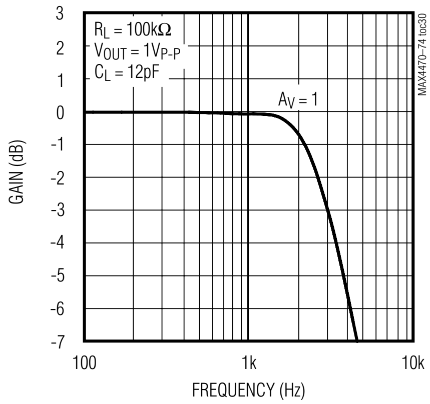
MAX4470/MAX4471/MAX4472
SMALL-SIGNAL GAIN vs. FREQUENCY



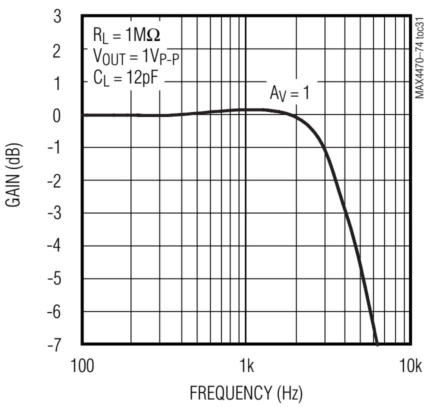
MAX4470/MAX4471/MAX4472
LARGE-SIGNAL GAIN vs. FREQUENCY



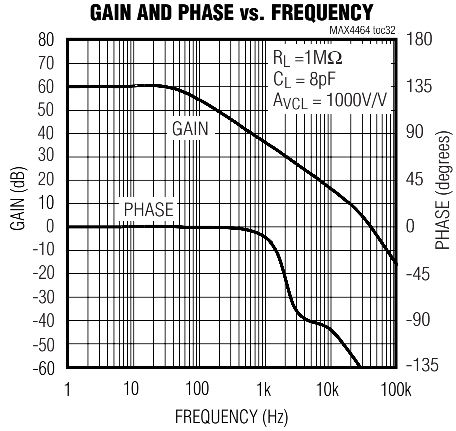
MAX4470/MAX4471/MAX4472
LARGE-SIGNAL GAIN vs. FREQUENCY



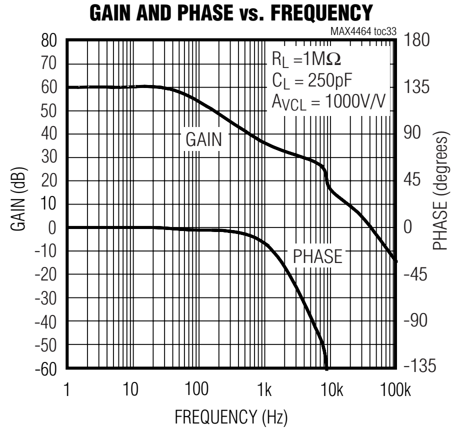
MAX4470/MAX4471/MAX4472
LARGE-SIGNAL GAIN vs. FREQUENCY



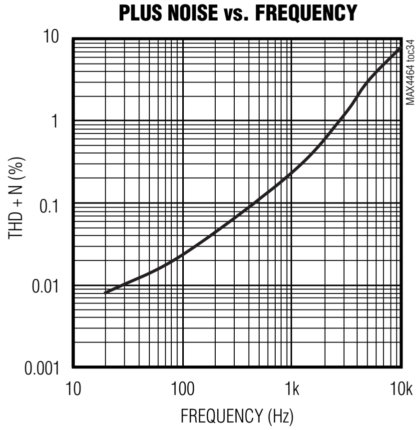
MAX4464/MAX4474
GAIN AND PHASE vs. FREQUENCY



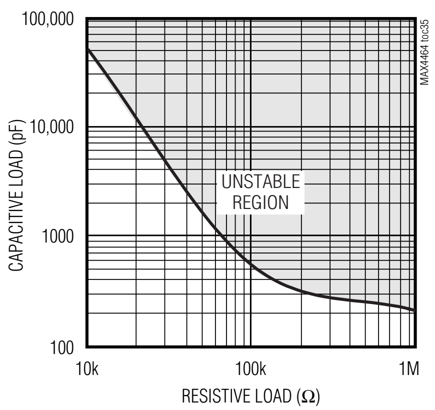
MAX4464/MAX4474
GAIN AND PHASE vs. FREQUENCY



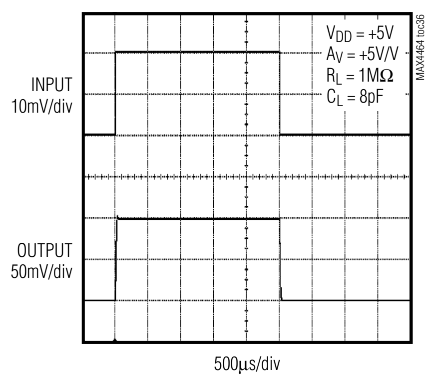
MAX4464/MAX4474
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY



MAX4464/MAX4474
STABILITY vs. CAPACITIVE AND RESISTIVE LOADS



MAX4464/MAX4474
SMALL-SIGNAL STEP RESPONSE

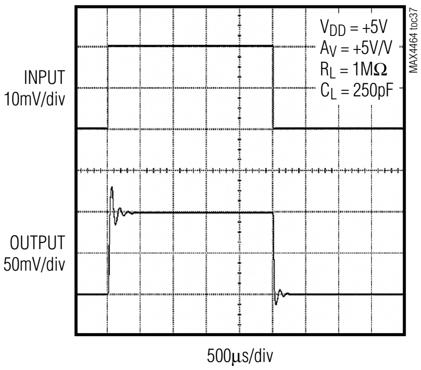


Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

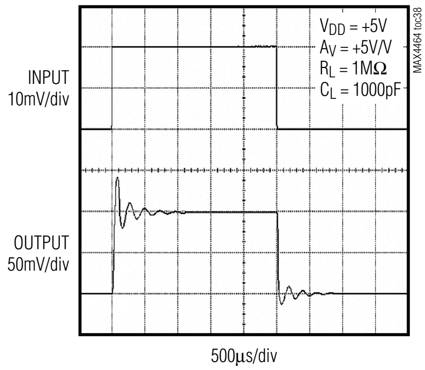
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

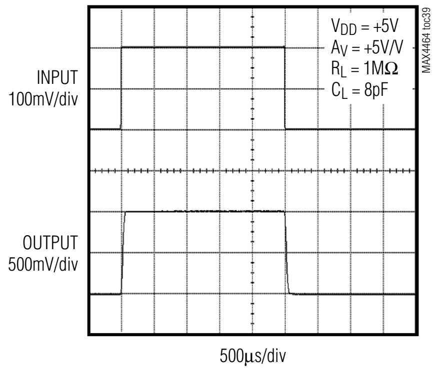
MAX4464/MAX4474
SMALL-SIGNAL STEP RESPONSE



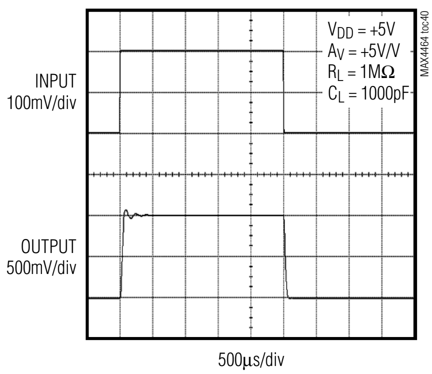
MAX4464/MAX4474
SMALL-SIGNAL STEP RESPONSE



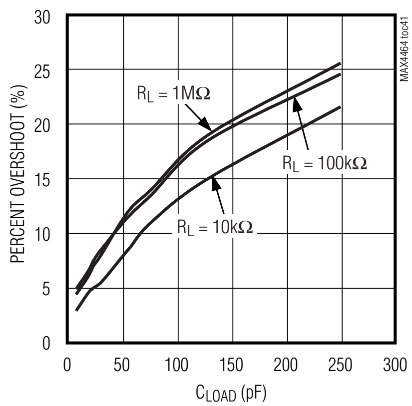
MAX4464/MAX4474
LARGE-SIGNAL STEP RESPONSE



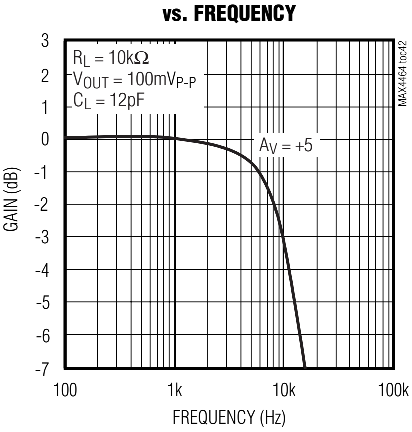
MAX4464/MAX4474
LARGE-SIGNAL STEP RESPONSE



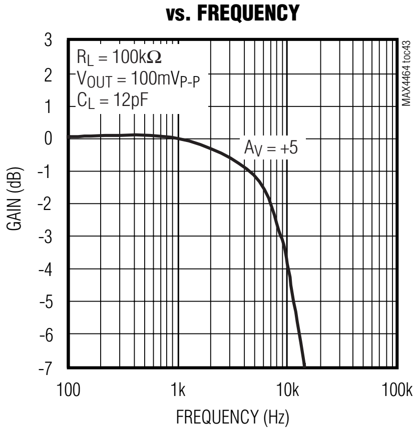
MAX4464/MAX4474
PERCENT OVERSHOOT vs. CAPACITIVE LOAD



MAX4464/MAX4474
SMALL-SIGNAL NORMALIZED GAIN
vs. FREQUENCY



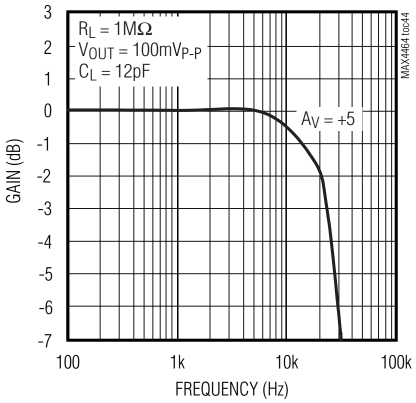
MAX4464/MAX4474
SMALL-SIGNAL NORMALIZED GAIN
vs. FREQUENCY



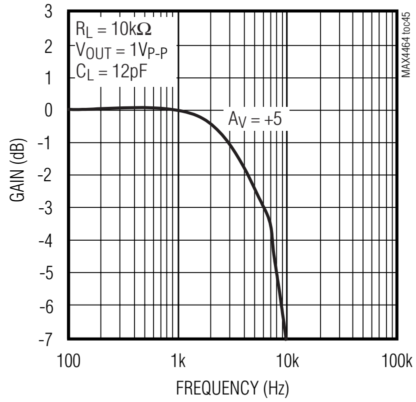
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0V, V_{CM} = 0V, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

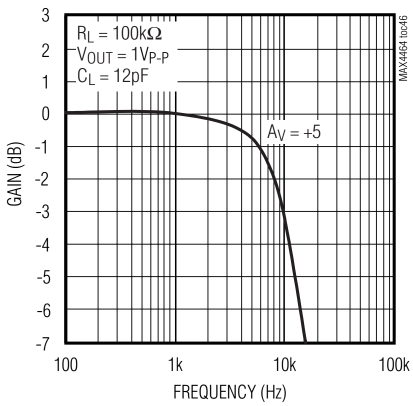
MAX4464/MAX4474 SMALL-SIGNAL NORMALIZED GAIN vs. FREQUENCY



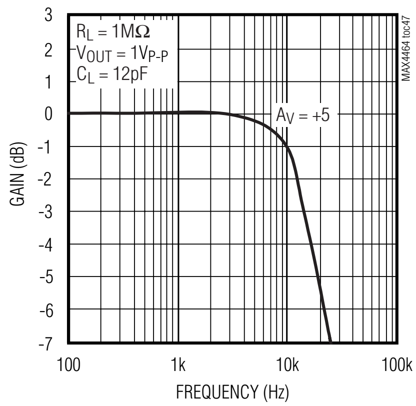
MAX4464/MAX4474 LARGE-SIGNAL NORMALIZED GAIN vs. FREQUENCY



MAX4464/MAX4474 LARGE-SIGNAL NORMALIZED GAIN vs. FREQUENCY



MAX4464/MAX4474 LARGE-SIGNAL NORMALIZED GAIN vs. FREQUENCY



Pin Description

PIN				NAME	FUNCTION
MAX4464/ MAX4470	MAX4470 (WLP)	MAX4471/ MAX4474	MAX4472		
1	A1	—	—	IN+	Noninverting Amplifier Input
—	—	3	3	INA+	Noninverting Amplifier Input (Channel A)
2	A2	4	11	V_{SS}	Negative Power-Supply Voltage
3	B1	—	—	IN-	Inverting Amplifier Input
4	C1	—	—	OUT	Amplifier Output
—	—	2	2	INA-	Inverting Amplifier Input (Channel A)

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

Pin Description (continued)

PIN				NAME	FUNCTION
MAX4464/ MAX4470	MAX4470 (WLP)	MAX4471/ MAX4474	MAX4472		
—	—	1	1	OUTA	Amplifier Output (Channel A)
—	—	6	6	INB-	Inverting Amplifier Input (Channel B)
—	—	5	5	INB+	Noninverting Amplifier Input (Channel B)
—	—	7	7	OUTB	Amplifier Output (Channel B)
—	—	—	9	INC-	Inverting Amplifier Input (Channel C)
—	—	—	10	INC+	Noninverting Amplifier Input (Channel C)
—	—	—	8	OUTC	Amplifier Output (Channel C)
—	—	—	13	IND-	Inverting Amplifier Input (Channel D)
—	—	—	12	IND+	Noninverting Amplifier Input (Channel D)
—	—	—	14	OUTD	Amplifier Output (Channel D)
5	B2	8	4	V_{DD}	Positive Power-Supply Voltage
—	C2	—	—	N.C.	No Connection. Not internally connected.

Applications Information

Ground Sensing

The common-mode input range of the MAX4470 family extends down to ground, and offers excellent common-mode rejection. These devices are guaranteed not to undergo phase reversal when the input is overdriven.

Power Supplies and Layout

The MAX4470 family operates from a single +1.8V to +5.5V power supply. Bypass power supplies with a 0.1µF ceramic capacitor placed close to the V_{DD} pin.

Ground layout improves performance by decreasing the amount of stray capacitance and noise at the op amp's inputs and outputs. To decrease stray capacitance, minimize PC board lengths and resistor leads, and place external components close to the op amps' pins.

Bandwidth

The MAX4470/MAX4471/MAX4472 are internally compensated for unity-gain stability and have a typical gain-bandwidth of 9kHz. The MAX4464/MAX4474 have a 40kHz typical gain-bandwidth and are stable for a gain of +5V/V or greater.

Stability

The MAX4464/MAX4470/MAX4471/MAX4472/MAX4474 maintain stability in their minimum gain configuration while driving capacitive loads. Although this product family is primarily designed for low-frequency applications, good layout is extremely important because low-power requirements demand high-impedance circuits. The layout should also minimize stray capacitance at the amplifier inputs. However some stray capacitance may be unavoidable, and it may be necessary to add a 2pF to 10pF capacitor across the feedback resistor as shown in Figure 1. Select the smallest capacitor value that ensures stability.

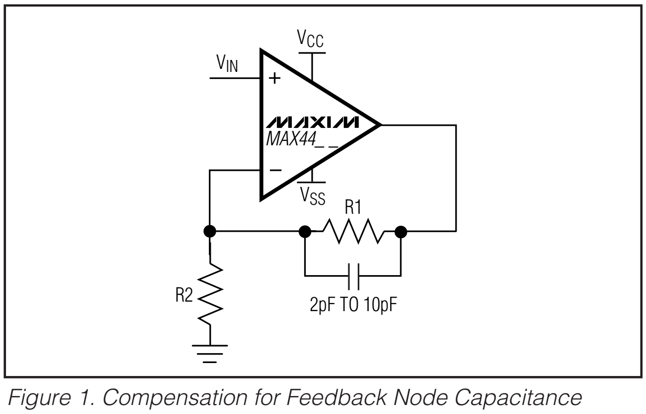
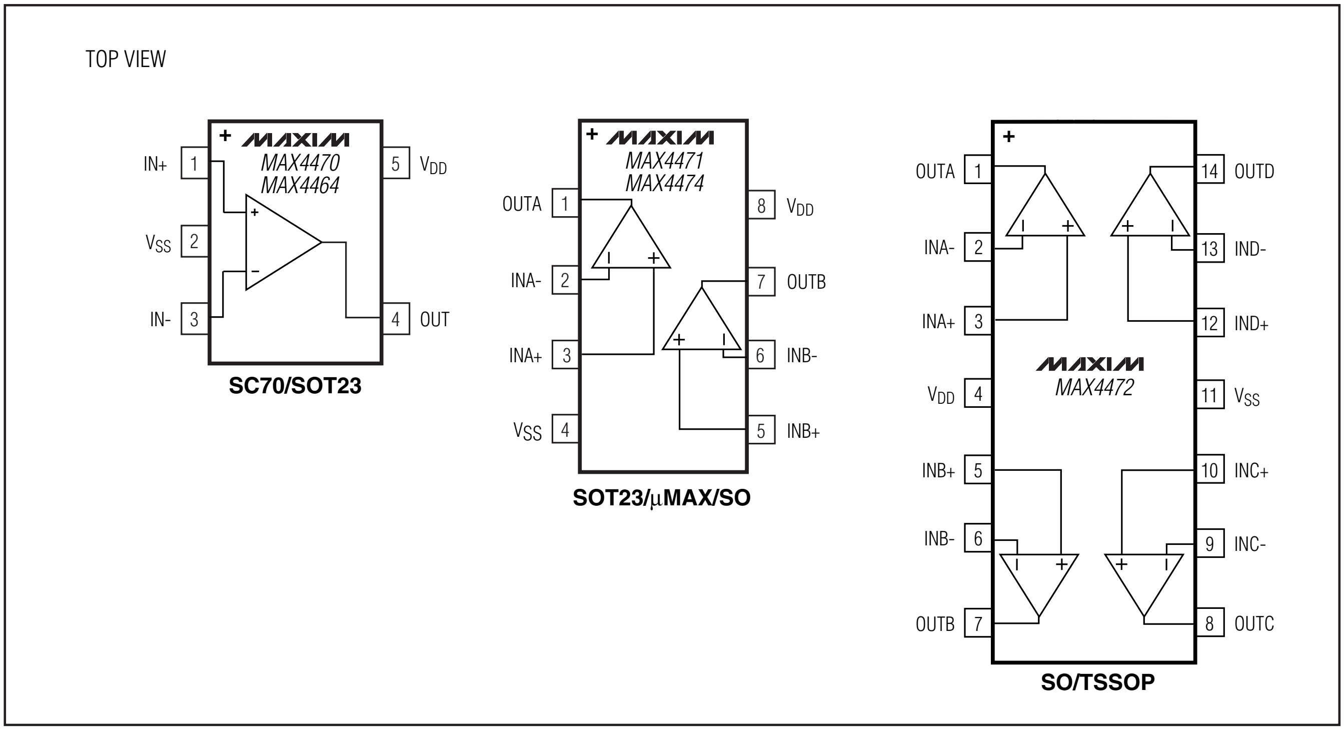


Figure 1. Compensation for Feedback Node Capacitance

Pin Configurations (continued)



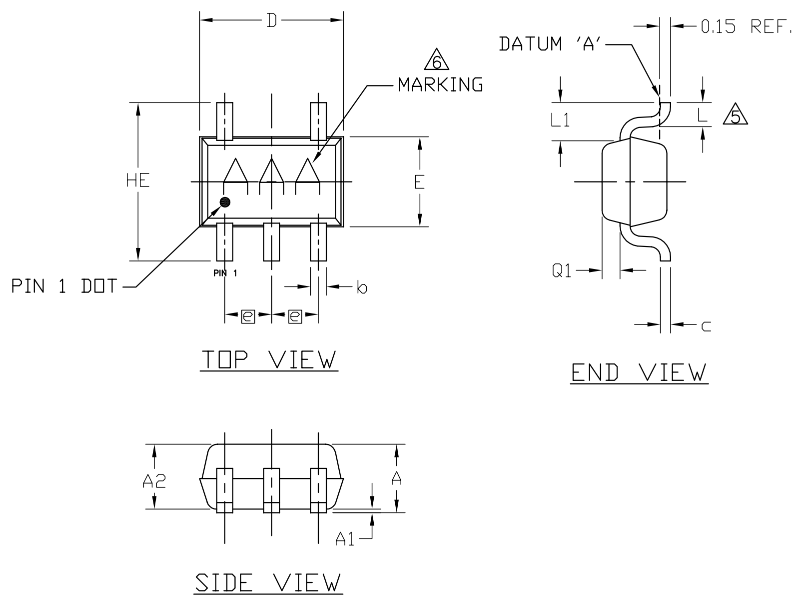
Chip Information

PROCESS: BiCMOS

Package Information

For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.	LAND PATTERN NO.
5 SC70	X5+1	**21-0076**	**90-0188**
5 SOT23	U5+1	**21-0057**	**90-0174**
6 WLP	W61B1+1	**21-0217**	Refer to **Application Note 1891**
8 µMAX	U8+1	**21-0036**	**90-0092**
8 SOT23	K8+5	**21-0078**	**90-0176**
8 SOIC	S8+2	**21-0041**	**90-0096**
14 SOIC	S14+1	**21-0041**	**90-0096**
14 TSSOP	U14+1	**21-0066**	**90-0117**



COMMON DIMENSIONS			
SYMBOL	MIN	NOM	MAX
A	0.80	0.95	1.10
A1	0.00	0.07	0.10
A2	0.80	0.90	1.00
b	0.15	0.22	0.30
c	0.10	0.14	0.18
D	1.80	2.00	2.20
e	0.65 BSC.		
E	1.15	1.25	1.35
HE	1.80	2.20	2.40
L	0.26	0.34	0.46
L1	0.425 TYP.		
Q1	0.10	0.25	0.40

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. COPLANARITY: 4 MILS. MAX.
5. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM "A" AND LEAD SURFACE.
6. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
7. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION "e", ±0.05.
8. COMPLY TO JEITA SC-88A EXCEPT FOR DIMENSION "L". ALL DIMENSIONS COMPLY TO JEDEC MO-203.
9. MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC # 10-0131.
10. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND LEAD FREE (+) PACKAGE CODES.
11. PKG CODE: X5-1

-DRAWING NOT TO SCALE-

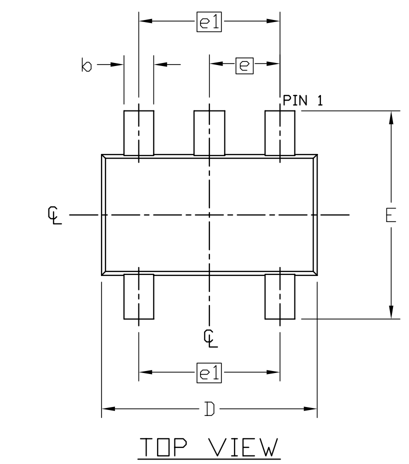
MAXIM

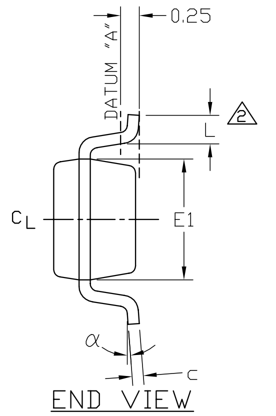
TITLE: PACKAGE OUTLINE, 5L SC70

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0076	F	1/1

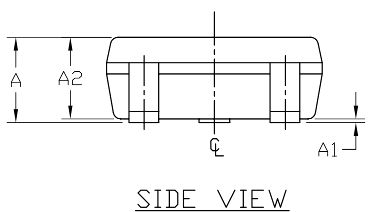
Package Information (continued)

For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.





SYMBOL	MIN	NOM	MAX
A	0.90	1.25	1.45
A1	0.00	0.05	0.15
A2	0.90	1.10	1.30
b	0.35	0.40	0.50
c	0.08	0.15	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.625	1.75
L	0.35	0.45	0.60
L1	0.60 REF		
e	0.95 BSC.		
e1	1.90 BSC.		
α	0°	2.5°	8°



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR. MOLD FLASH, PROTRUSION OR METAL BURR SHOULD NOT EXCEED 0.25 MM.
4. MEETS JEDEC MO178, VARIATION AA.
5. LEADS TO BE COPLANAR WITHIN 0.10 mm.
6. SOLDER THICKNESS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEAD TIP.
7. MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC # 10-0131.
8. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND LEAD FREE (+) PACKAGE CODES.
9. PKG CODES: U5-1, U5-2

MAXIM

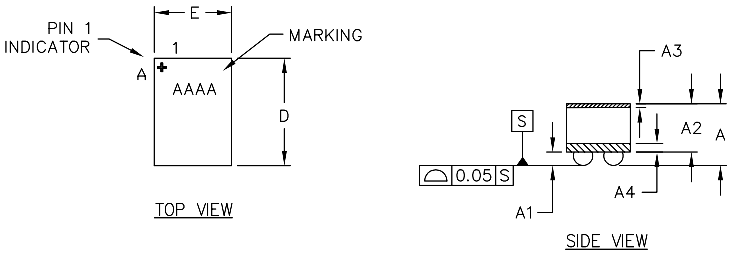
TITLE: PACKAGE OUTLINE, 5L SOT23

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0057	G	1/1

-DRAWING NOT TO SCALE-

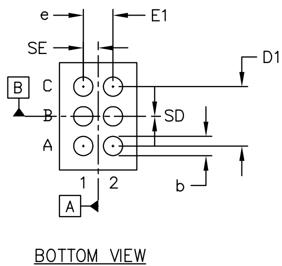
Package Information (continued)

For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.



COMMON DIMENSIONS	
A	0.64±0.05
A1	0.19±0.03
A2	0.45 REF
A3	0.025 BASIC
A4	0.07 BASIC
b	ø0.27±0.03
D1	0.80 BASIC
E1	0.40 BASIC
e	0.40 BASIC
SD	0.00 BASIC
SE	0.20 BASIC

PKG. CODE	E MIN	E MAX	D MIN	D MAX	DEPOPULATED BUMPS
W61B1+1	0.76	0.97	1.17	1.37	NONE
W61D1+1	0.95	1.02	1.36	1.42	NONE



NOTES:
1. Terminal pitch is defined by terminal center to center value.
2. Outer dimension is defined by center lines between scribe lines.
3. All dimensions in millimeters.
4. Marking shown is for package orientation reference only.
5. Tolerance is ± 0.02mm unless specified otherwise.
6. All dimensions apply to PbFree (+) package codes only.

MAXIM

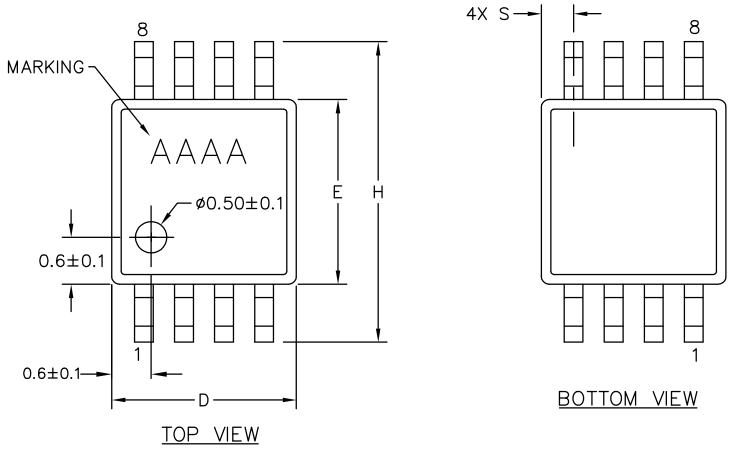
TITLE: PACKAGE OUTLINE 6 BUMPS, WLP PKG. 0.4mm PITCH

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0217	B	1/1

-DRAWING NOT TO SCALE-

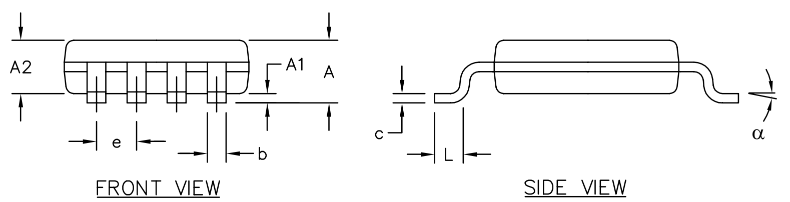
Package Information (continued)

For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.



	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	–	0.043	–	1.10
A1	0.002	0.006	0.05	0.15
A2	0.030	0.037	0.75	0.95
b	0.010	0.014	0.25	0.36
c	0.005	0.007	0.13	0.18
D	0.114	0.122	2.90	3.10
e	0.0256 BSC		0.65 BSC	
E	0.114	0.122	2.90	3.10
H	0.188	0.198	4.78	5.03
L	0.016	0.026	0.41	0.66
α	0°	6°	0°	6°
S	0.0207 BSC		0.5250 BSC	

PKG. CODES:
U8-1; U8-3; U8CN-1



NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15MM (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. COMPLIES TO JEDEC MO-187, LATEST REVISION, VARIATION AA.
5. MARKING SHOWN IS FOR PKG. ORIENTATION ONLY.
6. ALL DIMENSIONS APPLY TO BOTH LEADED (–) AND PbFREE (+) PKG. CODES.

–DRAWING NOT TO SCALE–

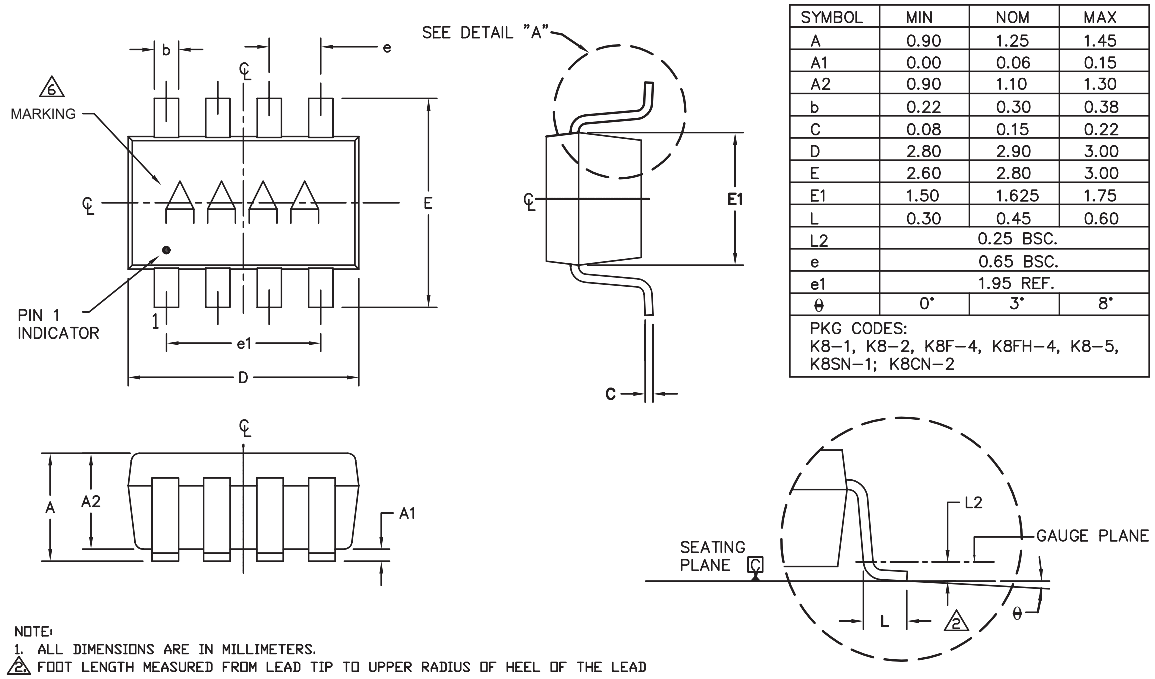
MAXIM

TITLE: PACKAGE OUTLINE, 8L uMAX/uSOP

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21–0036	L	1/1

Package Information (continued)

For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.



SYMBOL	MIN	NOM	MAX
A	0.90	1.25	1.45
A1	0.00	0.06	0.15
A2	0.90	1.10	1.30
b	0.22	0.30	0.38
C	0.08	0.15	0.22
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.625	1.75
L	0.30	0.45	0.60
L2	0.25 BSC.		
e	0.65 BSC.		
e1	1.95 REF.		
θ	0°	3°	8°

PKG CODES:
K8-1, K8-2, K8F-4, K8FH-4, K8-5, K8SN-1; K8CN-2

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED FROM LEAD TIP TO UPPER RADIUS OF HEEL OF THE LEAD PARALLEL TO SEATING PLANE C.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. COPLANARITY 4 MILS. MAX.
6. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
7. SOLDER THICKNESS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEAD TIP.
8. MEETS JEDEC MO178 VARIATION BA.
9. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND LEAD FREE (+) PACKAGE CODES.

-DRAWING NOT TO SCALE-

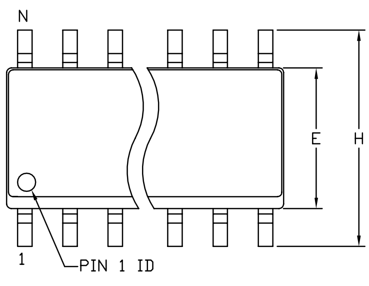
MAXIM

TITLE: PACKAGE OUTLINE, SOT-23, 8L BODY

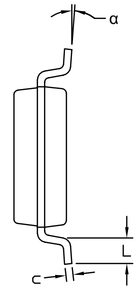
APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0078	J	1/1

Package Information (continued)

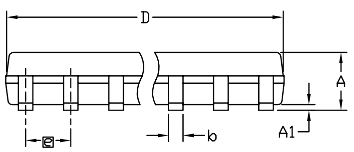
For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.



TOP VIEW



END VIEW



SIDE VIEW

COMMON DIMENSIONS				
SYMBOL	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
A	.053	.069	1.35	1.75
A1	.004	.010	0.10	0.25
b	.014	.019	0.35	0.49
c	.007	.010	0.19	0.25
E	.150	.157	3.80	4.00
e	.050 BSC		1.27 BSC	
H	.228	.244	5.80	6.20
L	.016	.050	0.40	1.27
α	0°	8°	0°	8°

VARIATION A				
SYMBOL	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
D	.189	.197	4.80	5.00
N	8			
MS012	AA			
PKG. CODE	S8-2, S8-4, S8-5, S8-6F, S8-7F, S8-8F, S8-10F, S8-11F, S8-16F			

VARIATION B				
SYMBOL	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
D	.337	.344	8.55	8.75
N	14			
MS012	AB			
PKG. CODE	S14-1, S14-4, S14-5, S14-6; S14M-4, S14M-5, S14M-6, S14M-7			

VARIATION C				
SYMBOL	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
D	.386	.394	9.80	10.00
N	16			
MS012	AC			
PKG. CODE	S16-1, S16-3, S16-5, S16-6, S16-8, S16-7F, S16-9F, S16-10F; S16M-3, S16M-6			

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC # 10-0131.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION IS 0.15 MM (.006") PER SIDE.
4. LEADS TO BE COPLANAR WITHIN 0.10mm (.004").
5. MEETS JEDEC MS012
6. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PbFREE (+) PKG. CODES.

-DRAWING NOT TO SCALE-

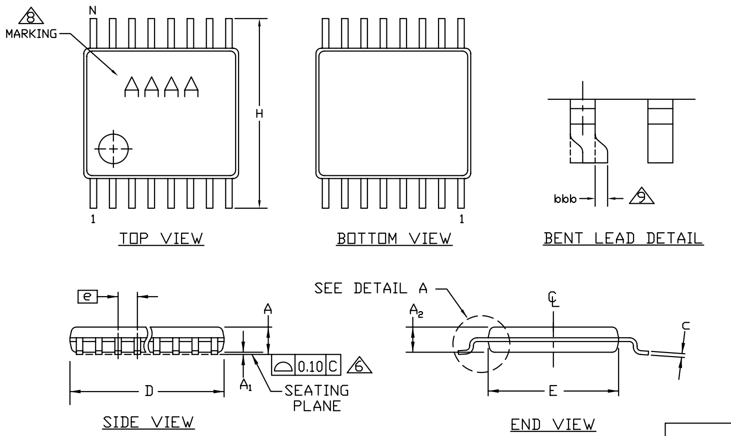
MAXIM

TITLE: PACKAGE OUTLINE, 8L, 14L, 16L SOIC .150 INCH

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0041	C	1/1

Package Information (continued)

For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.





SYMBOL	COMMON DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	—	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b_1	0.19	0.25	.007	.010
c	0.09	0.20	.004	.008
c_1	0.09	0.14	.004	.006
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.55	.246	.258
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°
bbb	0.10 MAX			

JEDEC MO-153	N	SYMBOL	PKG. CODES	VARIATIONS			
				MILLIMETERS		INCHES	
				MIN.	MAX.	MIN.	MAX.
AB-1	14	D	U14-1, U14-2, U14-3	4.90	5.10	.193	.201
AB	16	D	U16-1, U16-2, U16-1F, U16M-1	4.90	5.10	.193	.201
AC	20	D	U20-1, U20-2, U20-3, U20-5, U20-1F, U20M-2	6.40	6.60	.252	.260
AD	24	D	U24-1, U24-2	7.70	7.90	.303	.311
AE	28	D	U28-1, U28-2, U28-3	9.60	9.80	.378	.386

NOTES
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE
5. "N" REFERS TO NUMBER OF LEADS
6. LEAD COPLANARITY 0.10 MM MAX.
7. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY
8. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY
9. BENT LEAD 0.10 MM MAX.
10. MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC # 10-0131.
11. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PBFREE (+) PKG. CODES.

-DRAWING NOT TO SCALE-

MAXIM

TITLE: PACKAGE OUTLINE, TSSOP 4.40mm BODY

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0066	L	1/1

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
3	6/10	Added WLP package	1, 2, 9, 10, 11
4	7/11	Updated power-on time specification	3